Center for
Computational
Biology (CCB)

SHAPE REPRESENTATION AND SHAPE VIEWER

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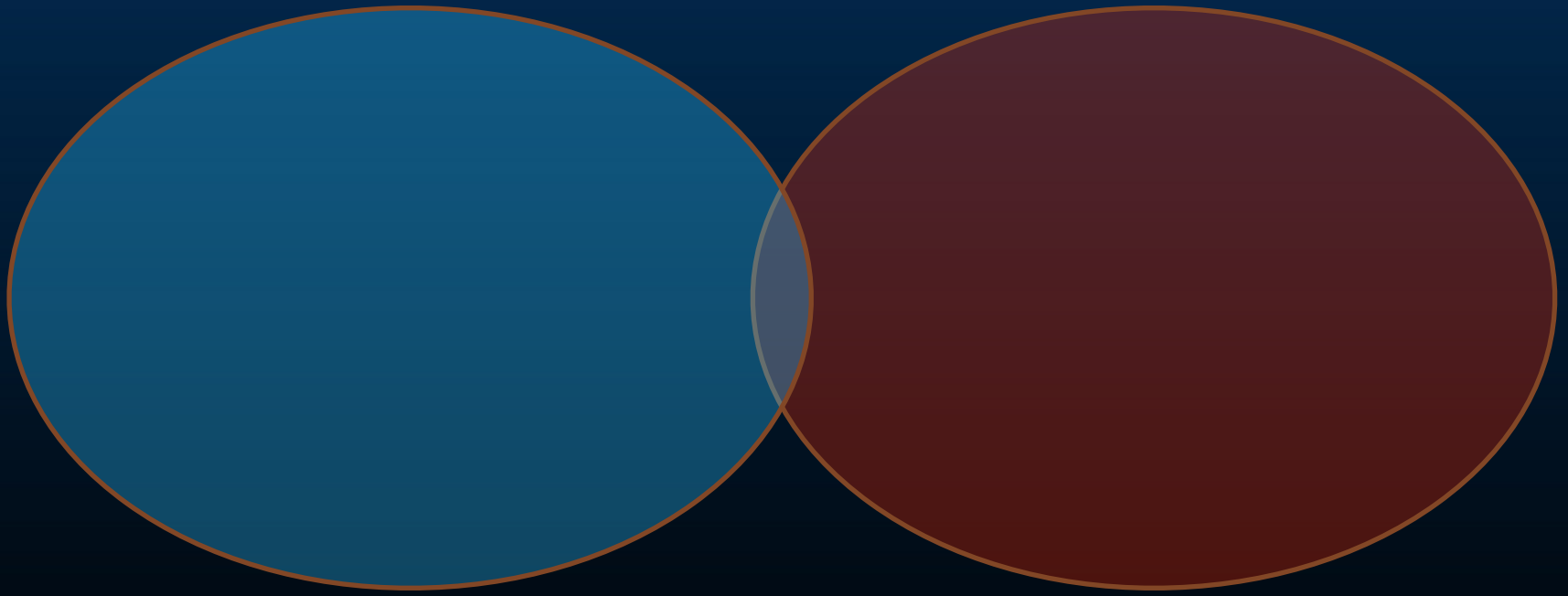
OBJECTIVES

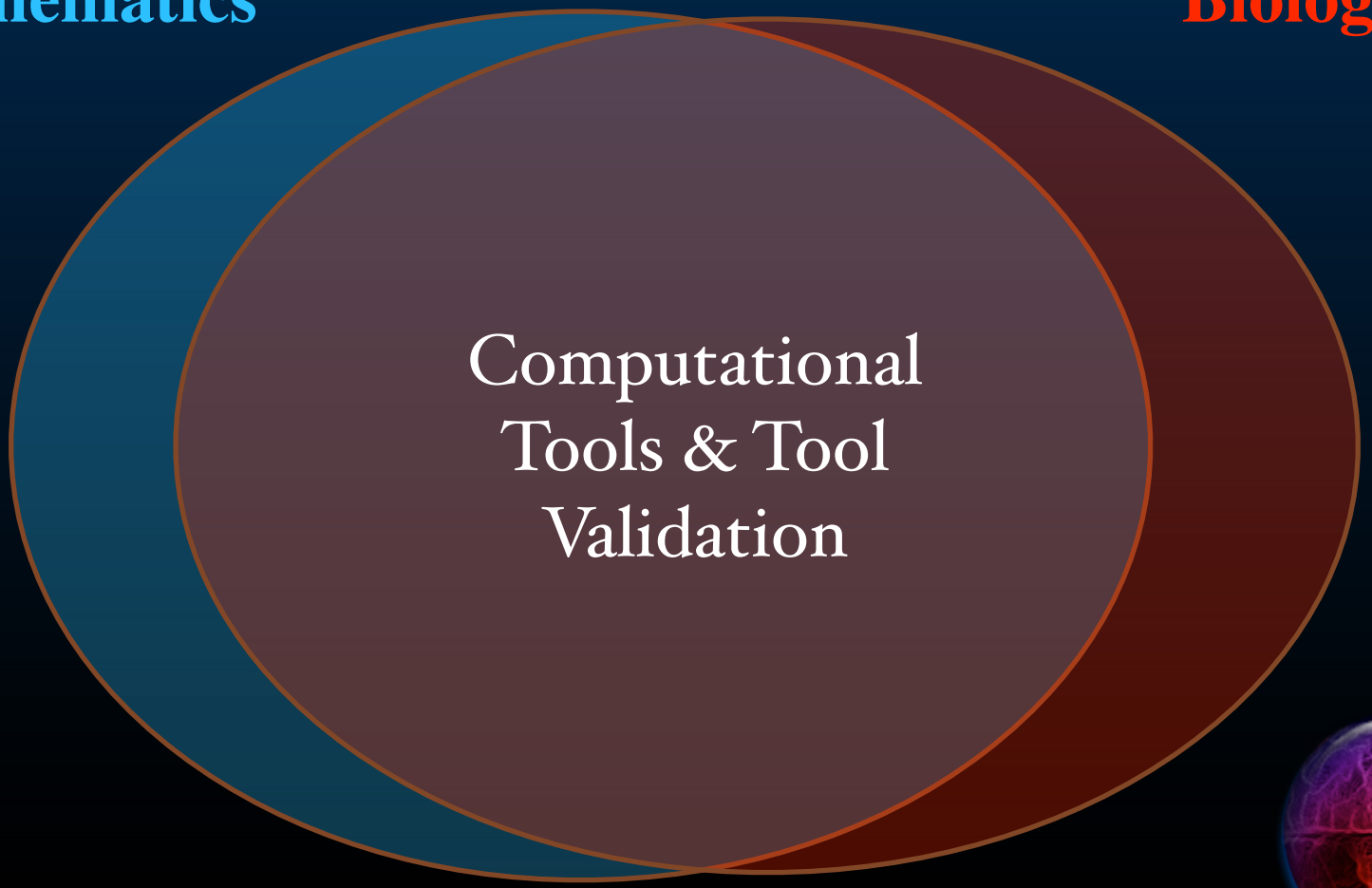
- What is the primary problem domain of the CCB?
- What is the primary problem domain of the Shape Tools development group?
- What types of biological problems can currently be addressed using products of the Shape Tools development group?
- How can the work of the Shape Tools group be leveraged by other developers?
- NOT a tool use tutorial

Mathematicians

Biologists



Role of Tools Within the NCBC



Lessons

- Importance of validation and interdisciplinary input
- In the imaging field, solutions to problems increasingly require novel mathematics, not just implementation of existing mathematics
- Biologists may value the reputation of software tools over their mathematical elegance or correctness

Shape Tools and Shape Viewer

- No new math (well, maybe a little)
- Upgrade of existing tools and infrastructure to support NCBC mandates for software sharing
- Coding performed by career programmers
- Biologists in the laboratory are delighted
- “Converting unmarked trails to superhighways”

Goal: Reduce Distance from Mathematical Concept to End User

- Developers should be able to load any test data set supplied by end users
- Even prototype code should be usable by end users
- A common visualization framework for developers and end users is desirable
- Code reuse should be maximized
- Performance optimization should be reserved for methods demonstrated to be useful

Shape Tools and ShapeViewer

- Java-based toolkit
- Java Image I/O API for reading and writing supported file formats
- Flexible and efficient internal representation of surfaces
- Integrated visualization tool
- Support for network based communication of surface visualization

Why Java?

- Supported on multiple platforms
- Widely taught language
- Java 3D API for visualization
- Good built-in network support
- Excellent integration with Matlab
- Straightforward integration with other prototyping and programming environments
  - R statistical package
  - C via Java Native Interface

Surface File Formats

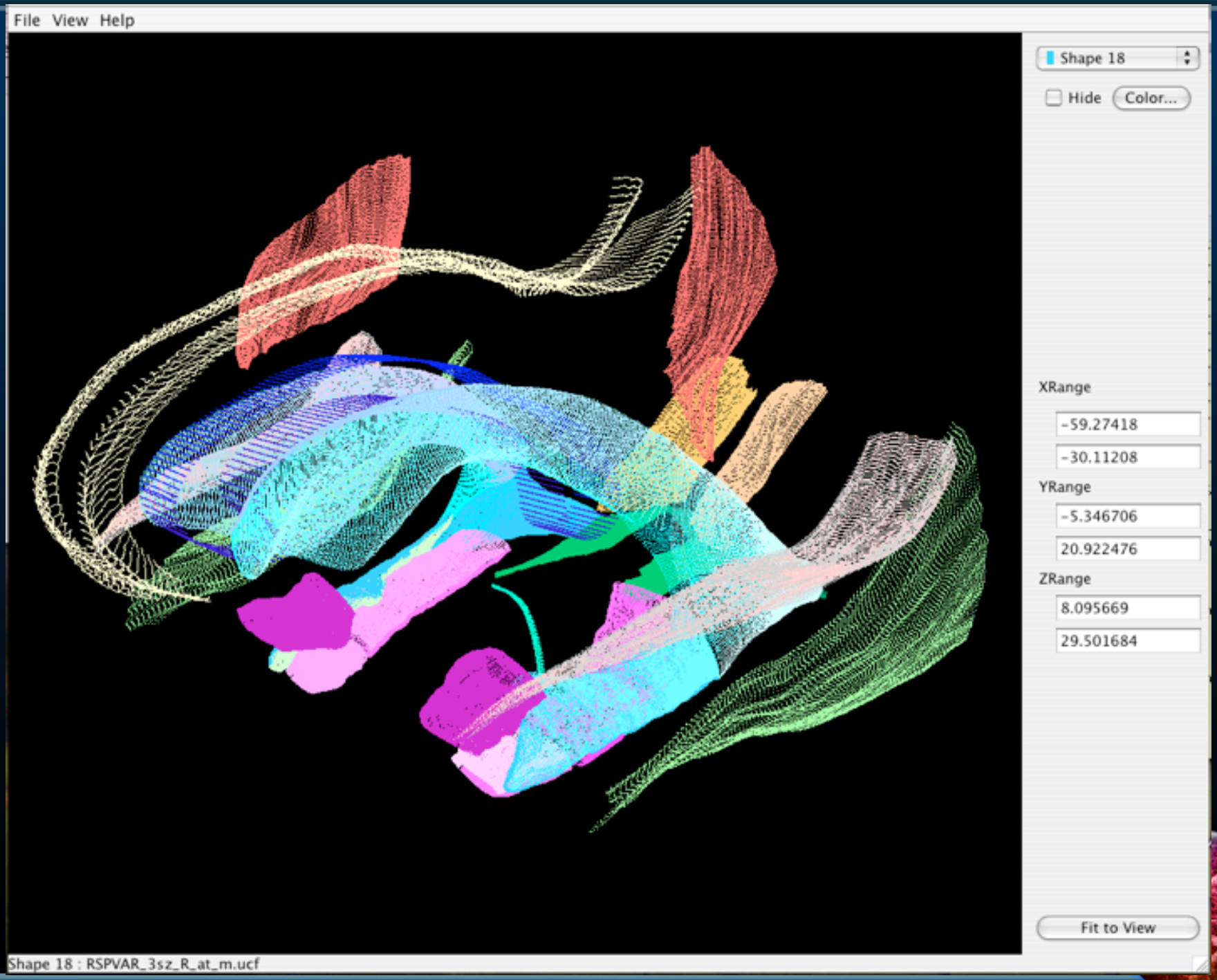
- UCF format
  - Traditional LONI contour format
  - Implicit generalization to meshes
- MINC format
  - Triangulated surface format
- OFF format
  - Generalized surface format
- Data Explorer format
  - Generalized surface format

Internal Surface Representation

- Explicit representation of 3D points
- Explicit representation of faces
  - Triangles, quads, arbitrary and mixed
- Explicit representation of adjacent faces
- Implicit representation of edges
- Attributes can be associated with points, edges or faces
- Attributes can be scalars, vectors, tensors, colors, etc

3D Visualization

- Requires Java 3D
- Support for wireframe and surface shaded models
- User interactive modification of view
- Display of multiple shapes simultaneously
- Affine compensation for different coordinate systems
- Color tables for attribute display


File View Help
Shape 18
Hide
Color...
XRange
-59.27418
-30.11208
YRange
-5.346706
20.922476
ZRange
8.095669
29.501684
Fit to View
Shape 18 : RSPVAR_3sz_R_at_m.ucf

Network Based Visualization

- Remote file system browser allowing ftp, sftp, http and local files to be loaded (also standalone project)
- ShapeViewer can be run as an applet in web browser
- Client/server capabilities built in to allow simultaneous display on different machines

Advanced ShapeViewer Features

- Ability to script interactively in Java
- Support for communication with other applications to adjust view

R Integration

- R is an open source version of S
  - used commonly by statisticians
- Interface to Shape Tools using modified version of rJava, an open source package
- Data in UCF, MINC, OFF, DX formats can be loaded and saved
- Convenience methods for getting and setting attributes and/or points without the need to understand the file formats

Acknowledgments

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  - Elizabeth Sowell